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Tensile Properties of Window Film

Name	3M Renewable Energy	Date:	July 3, 20104
Attn:	Paul Neumann	Revision Date:	September 18, 2014
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City, State, Zip:	St. Paul, MN 55144	Report Number:	ESP017051P-Ultra 600T
		Client Purchase Order Number:	USMMMNY51T

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INTRODUCTION

This report presents the results of tensile/elongation tests conducted on a sample of window film. The testing was authorized by Paul Neumann of 3M Renewable Energy on June 12, 2014. The testing and data analysis were completed on September 18, 2014.

The scope of our work was limited to conducting tensile/elongation tests on the sample submitted and reporting the results.

OBJECTIVE

Determine tensile/elongation properties of the window film.

SAMPLE IDENTIFICATION

The sample was identified as 3M™ Scotchshield™ Safety and Security Film Ultra 600

TEST METHOD

The specimens were allowed to condition at standard laboratory conditions of $72 \pm 4^{\circ}\text{F}$ and $50 \pm 5\%$ relative humidity for at least 40 hours prior to testing. Testing was done according to ASTM Standards detailed below, with notes of parameters and/or deviations.

Test Method	Test Method Title	Parameters and/or Deviations from Method
ASTM D882	Standard Test Method for Tensile Properties of Thin Plastic Sheeting	Test Speed 2 in./min.

CALIBRATED TEST EQUIPMENT

Honeywell Temp/RH Chart Recorder, S/N 7852 243000007, ID MM190-024 calibrated 8/7/13 calibrated 8/5/14, due 8/5/15

MTS Universal Test Machine, Mdl Qtest / 50LP, System #1532, ID MM210-009.3 & 6 calibrated 4/8/14 due 4/8/15

MTS Load Cell, 2250lbf Capacity, S/N 205974, ID MM210-009.1 calibrated 4/8/14 due 4/8/15

Mitutoyo Digimatic 8" Calipers, S/N 0006565, ID MM160-068 calibrated 8/8/13, calibrated 8/5/14, due 8/5/15

Mitutoyo Digimatic Indicator, Model C1012CMX, S/N 09040960, ID PT163-021 calibrated 8/8/13, calibrated 8/5/14, due 8/5/15

TEST RESULTS

Tensile

Specimen	Width, in	Thickness, in	Peak Load, lbs	Stress at Yield, psi	Stress at Break, psi	Elongation at Yield, %	Elongation at Break, %	Modulus, ksi
MD - 1	1.003	0.006	150.7	15113	25035	7.64	81.97	551.3
2	1.003	0.006	178.4	15036	29644	8.10	104.44	540.1
3	1.002	0.006	175.8	15102	29246	7.85	102.01	533.9
4	1.004	0.006	187.3	15145	31098	7.53	113.36	545.4
5	1.003	0.006	188.1	15182	31249	8.11	115.61	523.9
Average	1.003	0.006	176.1	15116	29254	7.85	103.48	538.9
Standard Deviation	0.047	0.000	0.000	15.2	54	2517	0.26	13.33
TD - 1	1.020	0.006	162.1	****	26480	****	92.54	598.8
2	1.001	0.006	154.9	****	25788	****	82.43	645.2
3	1.000	0.006	160.6	****	26771	****	88.63	594.0
4	1.008	0.006	165.5	****	27369	****	97.37	591.1
5	1.004	0.006	164.0	****	27231	****	94.90	608.1
Average	1.007	0.006	161.4	#DIV/0!	26728	#DIV/0!	91.17	607.4
Standard Deviation	0.025	0.000	0.000	4.1	#DIV/0!	635	#DIV/0!	5.86

* = for films tested with adhesive layer the thickness was reduce by 0.001 inch to account for the adhesive layer

Respectfully submitted,



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